GE
Digital Energy

Indiana Wind Working Group

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Policy Development

September 3, 2010

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Geopolitical drivers …

Source: International Energy Agency

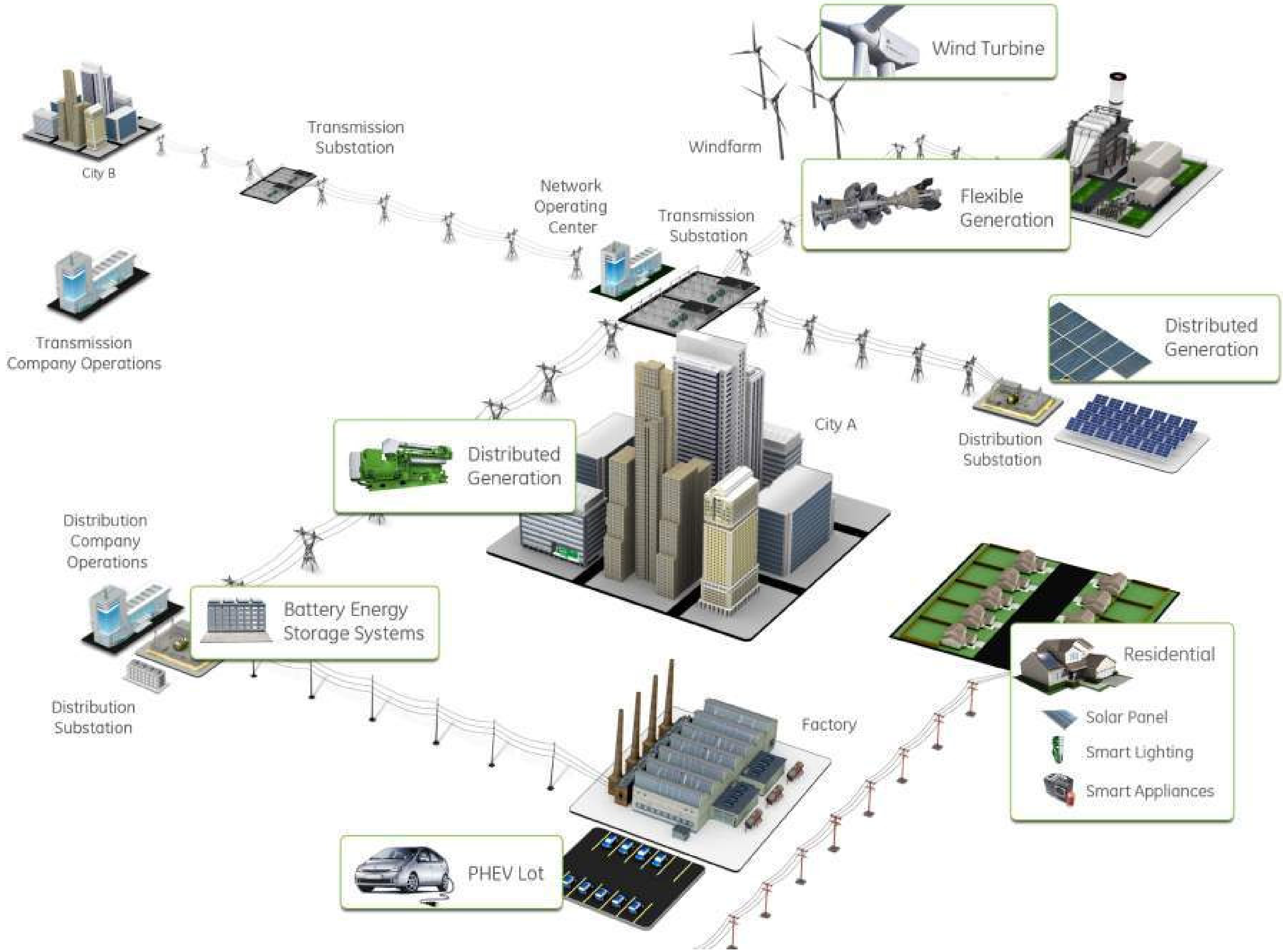
Source: International Energy Agency

Source: American Council for an Energy-Efficient Economy

Growth drivers …

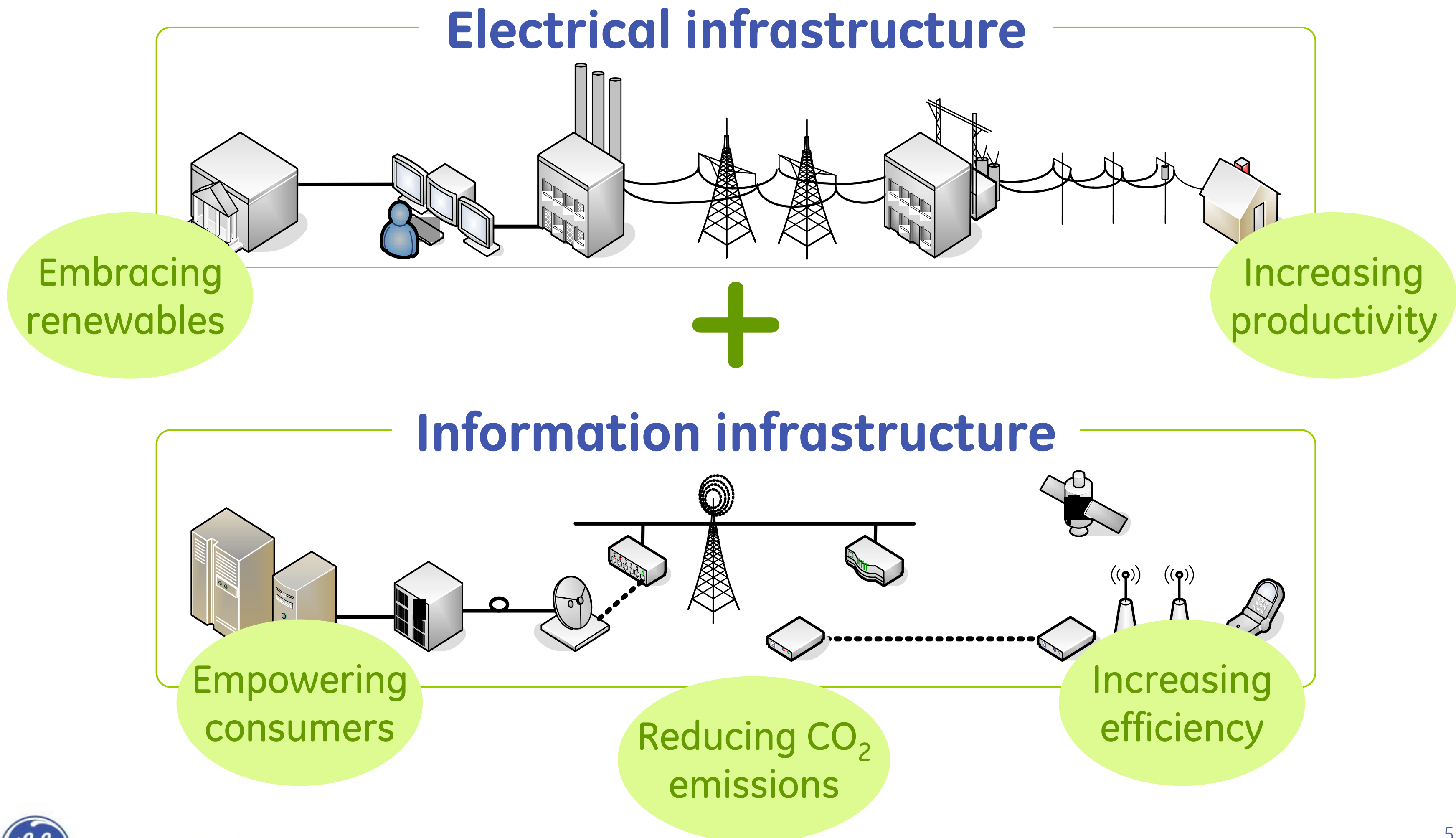
Economic competitiveness | Energy security | Empowerment-Consumer | Environmental sustainability

Resulting in growing grid complexity



So what is a Smart Grid?

The integration of two infrastructures … securely …



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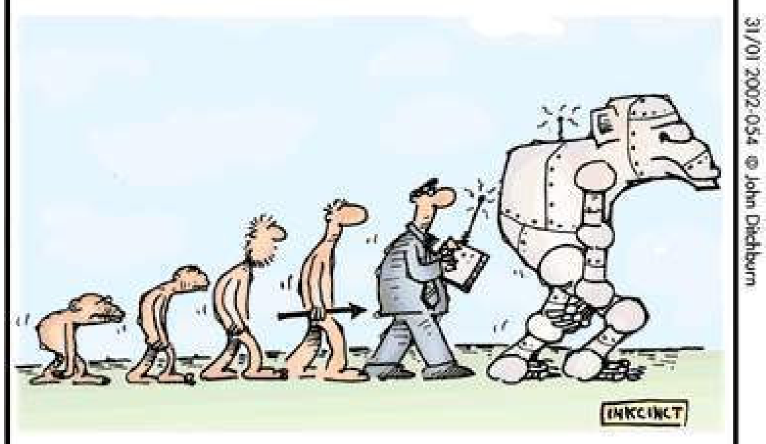
Sources: (1) UtilityPoint, by Ethan Cohen 7/18/0 (2) EPRI® Intelligrid

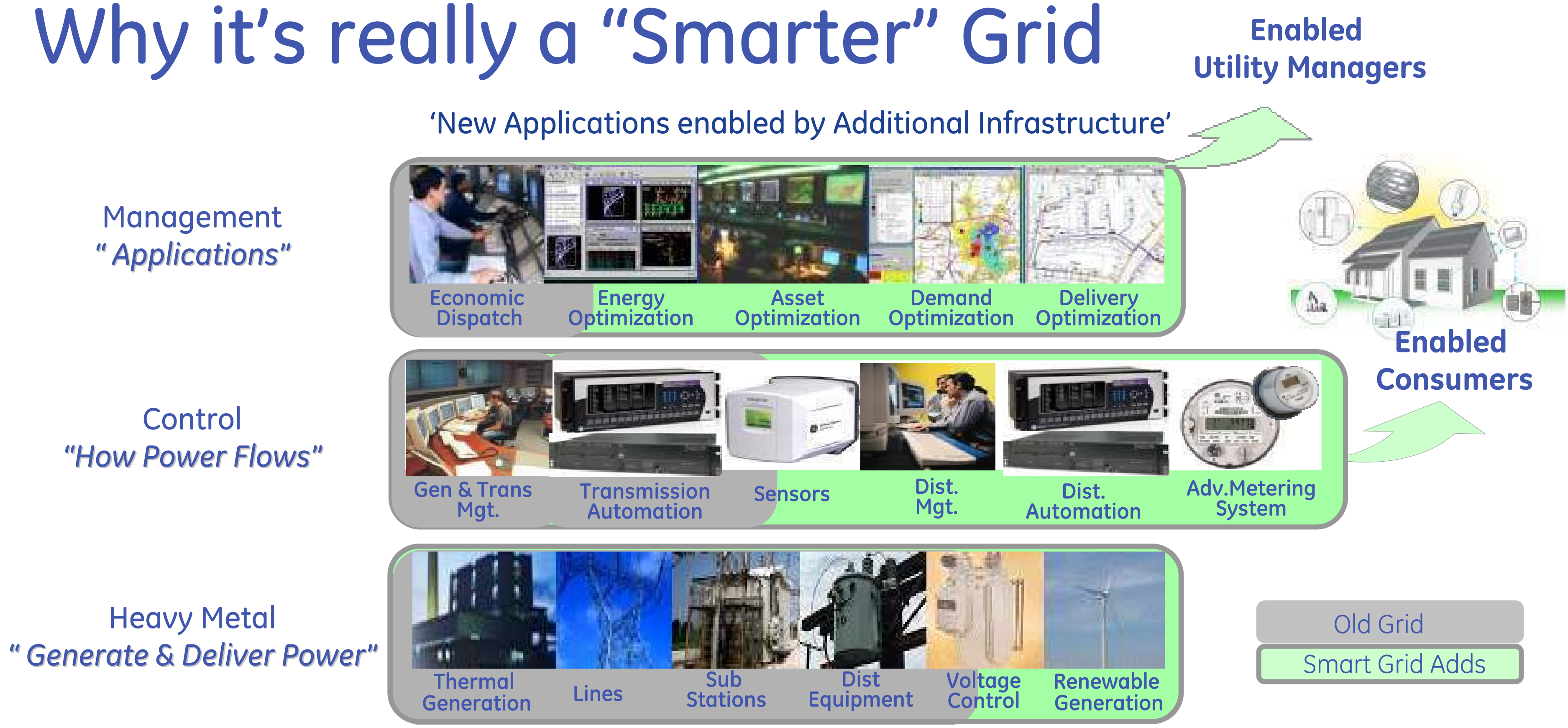
How is a Smart Grid created?

- Not created all at once … will ***evolve*** over many years
- Created through the incremental deployment and integration of ***system intelligence***
- Intelligent systems deployed to meet specific business and regulatory ***drivers***
- Each utility has different starting points, drivers, paths and deployment rates



The ascent of man.

Why it's really a "Smarter" Grid



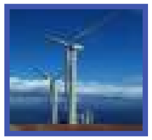
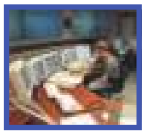
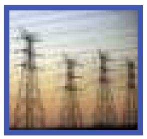
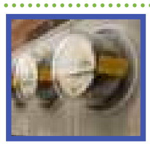
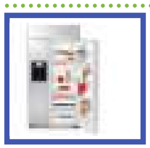
Old Grid

- You call when the power goes out.
- Utility pays whatever it takes to meet peak demand.
- Difficult to manage high Wind and Solar penetration.
- Cannot manage distributed generation safely.
- ~10% power loss in T&D

Smart Grid

- Utility knows power is out and usually restores it automatically.
- Utility suppresses demand at peak. Lowers cost. Reduces CAPEX.
- No problem with higher wind and solar penetration.
- Can manage distributed generation safely.
- Power Loss reduced by 2+%... lowers emissions & customer bills.

Elements of today's Smart Grid

	Offerings	Customer Benefits	Future Enablers
	Grid-Friendly Renewables	Controllability: Ramp, curtail... Reduced uncertainty: forecast	Stronger tie with utility EMS Coordination with DER & loads
	Grid Control Systems	Operating efficiency System reliability	'Ever Green' Service Modular applications
	Substation Digitization	Modular/standard Less cost, time, risk	IEC 61850 Compliant Open architecture
	Intelligent Electronics	Performance monitoring Control devices	Standards based IEC 61850 compliant
	Monitoring & Diagnostics	Asset protection Life extension	Progressive offering Long term services
	Communications Infrastructure	Performance visibility Remote control	Seamless NMS, Security Multi applications
	Smart Metering	Customer billing Demand management	Software upgradeable
	Smart Appliances & Home Controls	Participation in DR programs Utility bill savings	Standards based Software upgradeable

GE's Smart Grid landscape

Core

Generation optimization
Renewable integration
Distributed generation mgmt
Microgrids
Protection & control

Grid diagnostics & visualization
Reliability & demand forecasting
Grid protection & control
Fault detection & restoration
Wide area measurement system
Substation digitization
Transformers & voltage management
Distribution, outage mgmt systems
Geospatial information systems

Asset monitoring & diagnostics
Backup power mgmt & control
Energy management systems
Plant load management
Protection & control
Sub-metering TOU reporting

Smart meters
Wireless AMI
Smart appliances

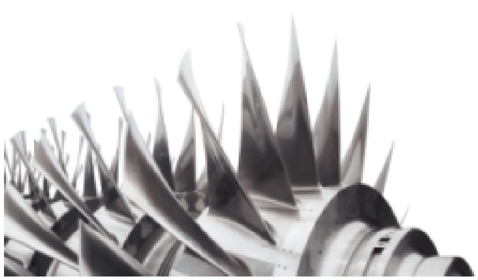
Emerging

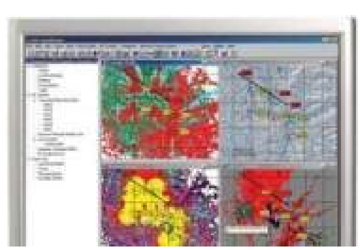
Storage management
Intermittency management

Energy storage systems
Cyber security
SG network planning & design

Demand management
Demand response
Billing automation

Home area networks
Renewable integration
Demand response & TOU pricing
Home energy use monitoring
PHEV integration
Neighborhood microgrids





GE's Smart Grid solutions

Demand optimization
Reducing peak demand, empowering consumers, deferring infrastructure investment

Distribution optimization
Improving reliability and efficiency, integrating renewables

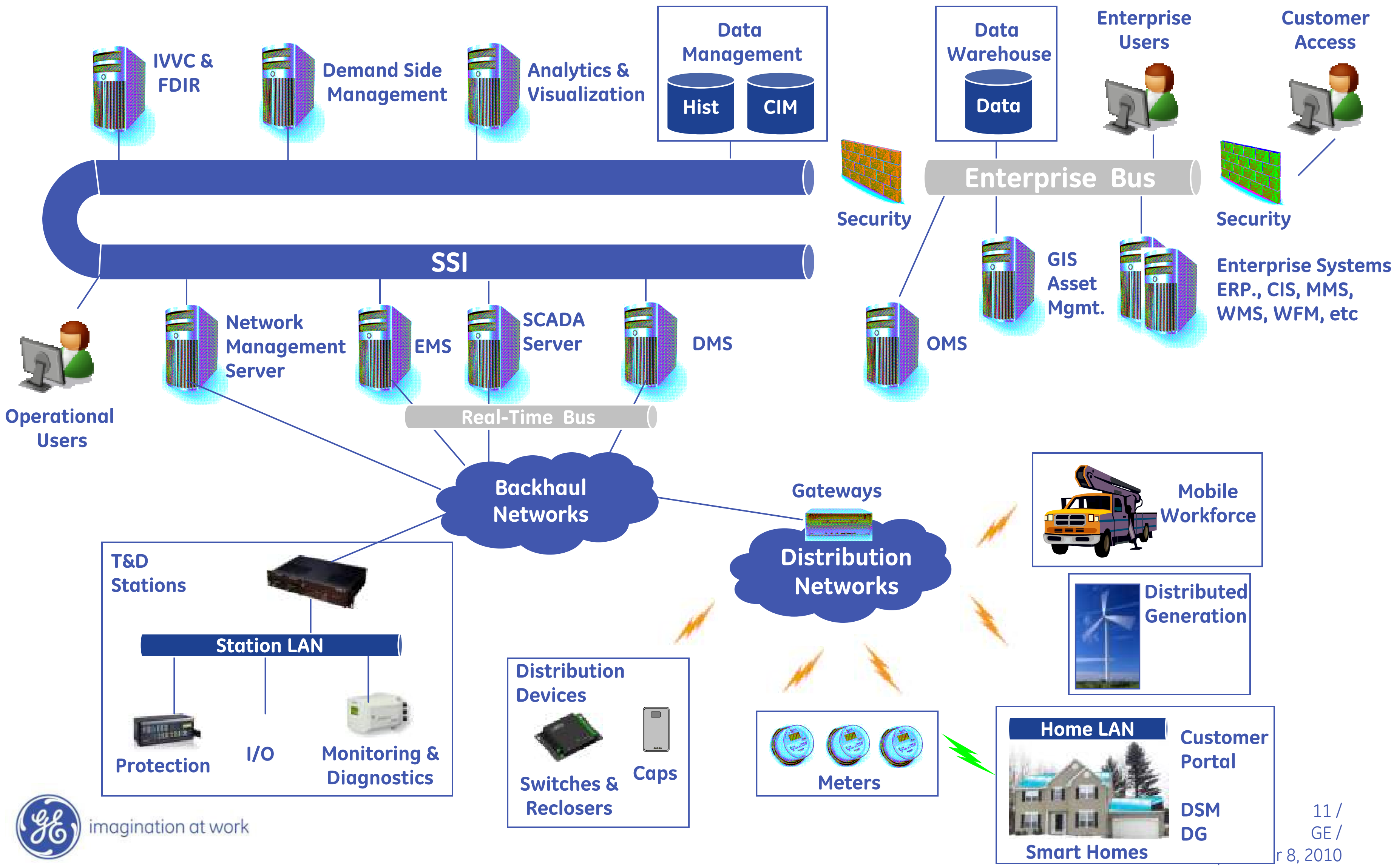
Asset optimization
Reducing outages and unexpected transformer failure, maximizing life of aging assets

Transmission optimization
Improving reliability and efficiency, integrating centralized renewables, wide area protection

Workforce & engineering optimization
Increasing productivity , cost-effective grid design

Working together to provide customer solutions

A systems view of how it all fits together



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Smart Grid
Recent Deployments

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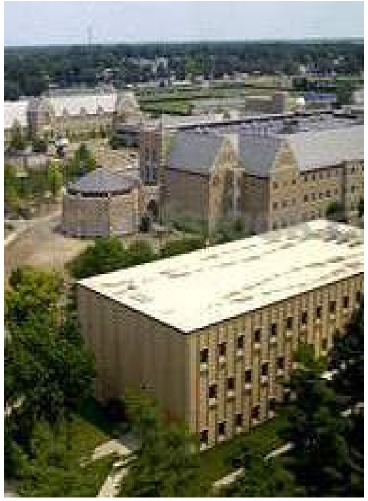
Smart Grid at work

PG&E
California

South Bend
Indiana



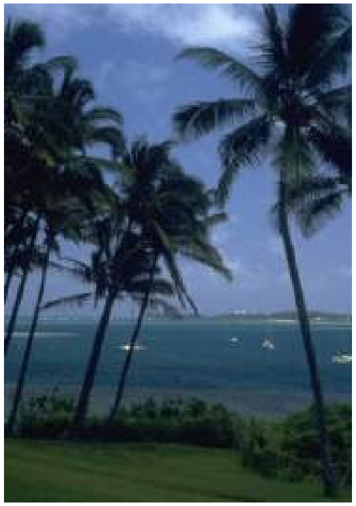
Miami
Florida

Columbus
Ohio

Bella Coola
Canada

National Grid
New England

Maui
Hawaii



Smart Grid at work

Real. Efficient. Solutions.

Project Scope:

- Enhanced customer experience
- Operational and energy efficiencies

Technology:

- Demand Optimization: Smart meters with communication, home area networks, smart appliances
- Distribution Optimization: DMS, OMS, Volt-Var Control
- Asset Optimization
- Integration of all components

Expected Benefits:

- Lowering voltage by as much as 3%; reducing consumer demand
- Power factor approaching .98
- Generate less power to meet the same consumer demand

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AEP's South Bend pilot project

gridSMART
from American Electric Power

- GE named a Smart Grid Alliance Partner
- ~10k customers
- 4 substations / 8 circuits
- 25 Capacitors / 25 Reclosers
- Deployment over 18 months (complete)
- On-going evaluation thru 2010

From the AEP website:

- The technology that allows AEP to manage its grid from our back office systems, such as billing, to the meter and distribution field equipment works. But the technology that goes beyond the meter into the customer's home is still evolving.
- Customers who participated in the time-of-day rate plan did shift their demand to different times, as expected.
- Cost savings from better system management, fewer crew trips, reduced fuel consumption, better theft detection and streamlined billing are being achieved.
- During the cooling season, customers who volunteered allowed us to raise the temperature in their homes using a programmable, communicating thermostat, demonstrating that we can control customer usage directly between the meter and the home through wireless technology.
- More education of consumers will be needed in future projects.

Transforming the way AEP does business to better serve our customers, improve reliability, reduce costs and lower emissions.

Smart Grid at work

Real. Clean. Solutions.

<u>Project Scope:</u>

Develop a Smart Grid controls and communication architecture capable of coordinating DG, energy storage and loads

<u>Technology:</u>

• Demand Response systems and VOLT/VAR technologies help manage peak load

• Grid management software - optimize the integration of wind and solar power.

<u>Expected Benefits:</u>

• Reduce peak load by 15% relative to loading on the distribution circuit.

• Mitigate the impacts of short-timescale wind and solar variability on the grid

Maui Electric Company, Ltd.

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Smart Grid at work

Real. Holistic. Solutions.

<u>Project Scope:</u>

Energy Smart Florida - a groundbreaking public/private alliance of the City of Miami, FPL, GE, Silver Spring Networks and Cisco - is using federal economic stimulus funds as part of its $800 million investment in smart grid technology and renewable energy

<u>Technology:</u>

- Smart Meters - An estimated 4.5 million smart meters will be installed on homes and businesses by 2014
- Demand Management
- Distribution Automation
- Substation Intelligence
- Distributed Generation
- Enterprise Systems

<u>Expected Benefits:</u>

- Potential to slash CO2 emissions
- Optimize distributed renewable energy deployments
- Reduce power disturbances more than 75% by 2020
- Increase energy efficiency through demand optimization and distribution automation delivering 3+% peak load reduction.
- Create 800-1,000 "green collar" jobs

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Driving Smart Grid Through Standards and Policy

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Who makes standards anyway?

International Standards (ISO, IEC)

National Standards (ANSI, NIST, IEEE)

Industry Standards - formalized practice

Industry Practice - informal practice

Proprietary Systems - vendor specific

The need for a roadmap

- Capabilities
- Priorities
- Architecture
- Standards
- Release Plan
- Responsibilities
- Governance
- Conformity

(including testing and certification where appropriate)

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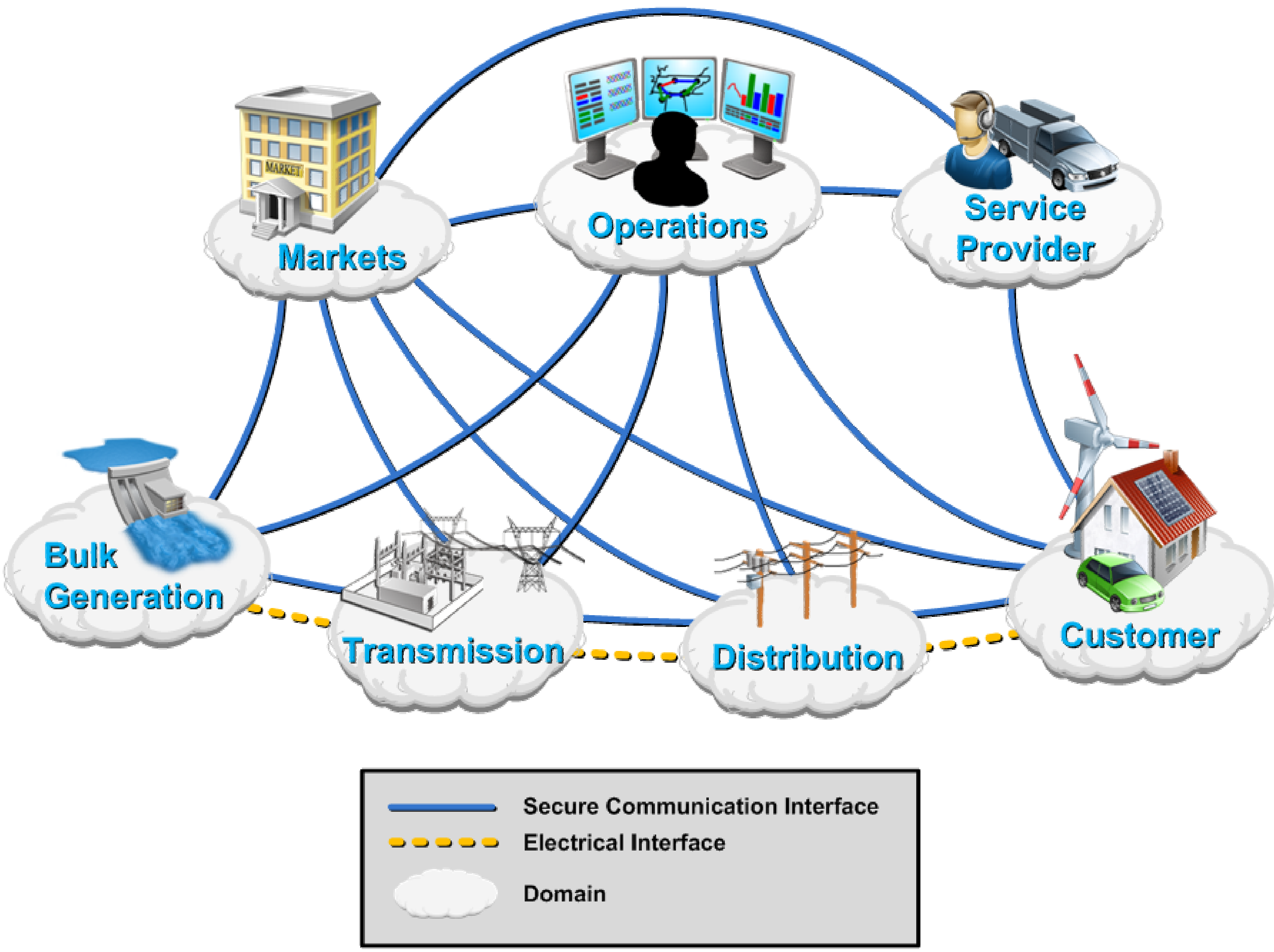
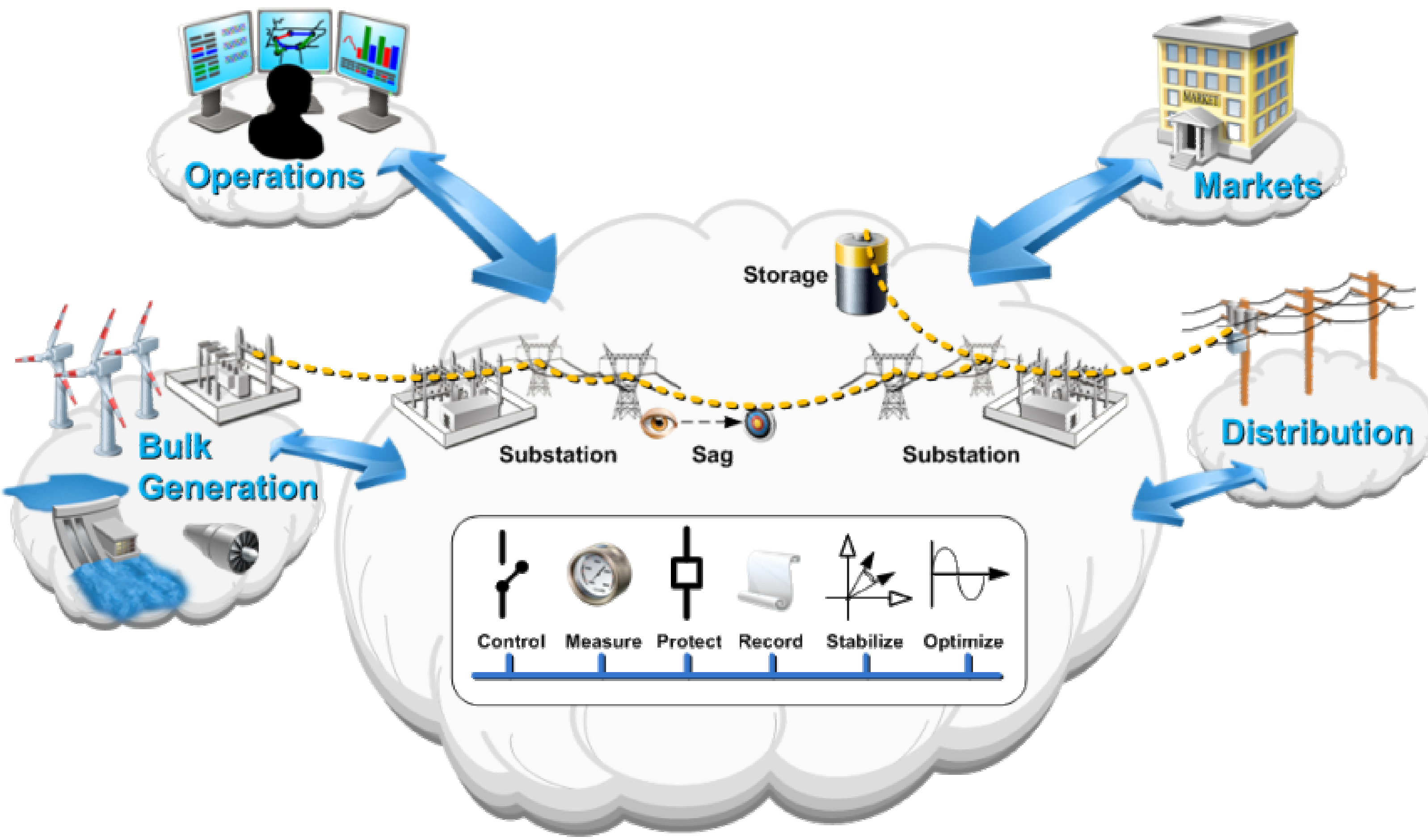
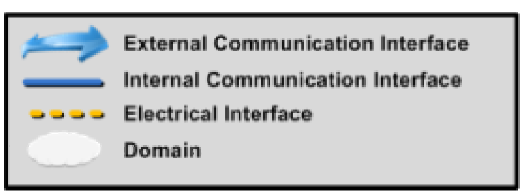
NIST conceptual model



NIST conceptual model ... transmission





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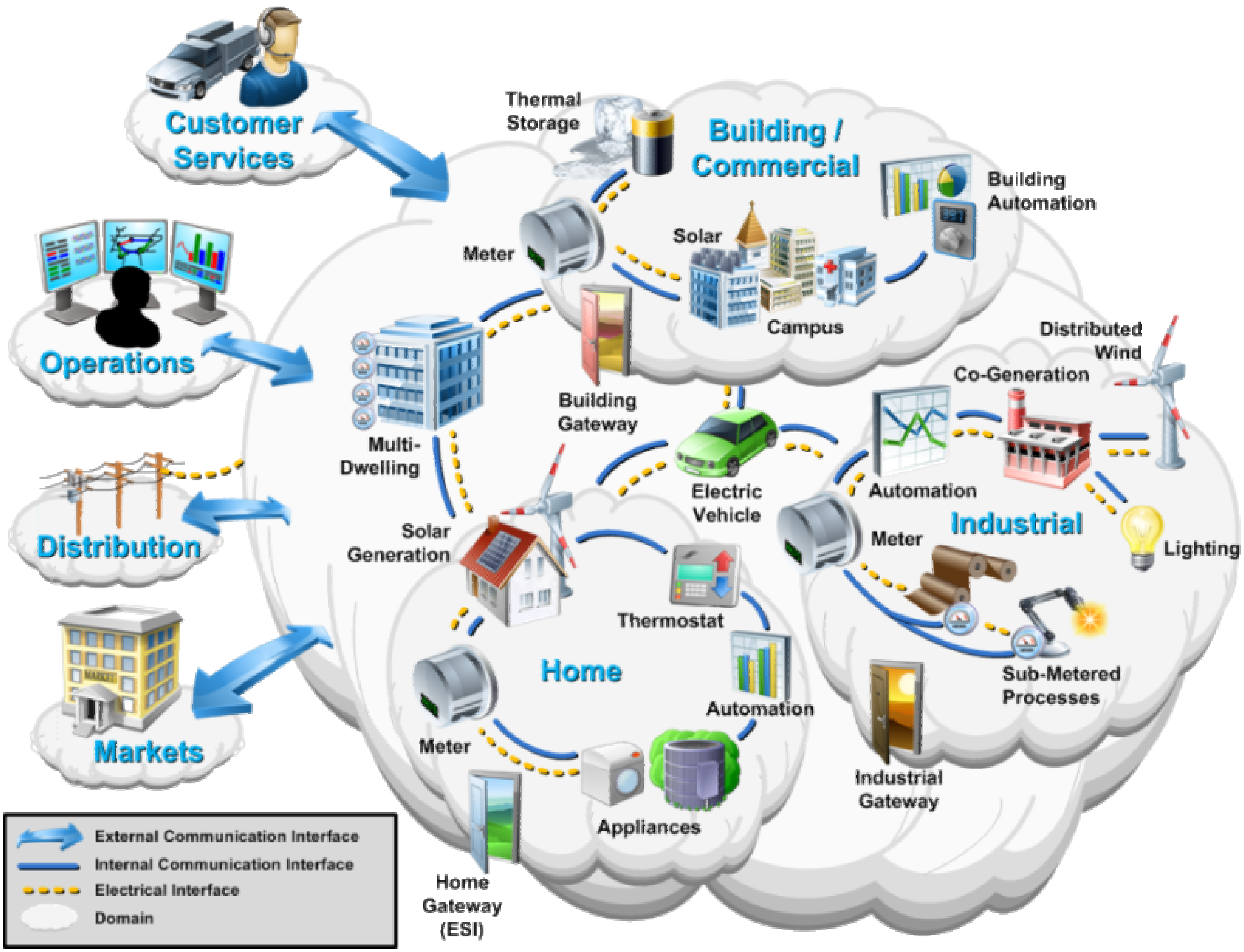
NIST conceptual model … customer



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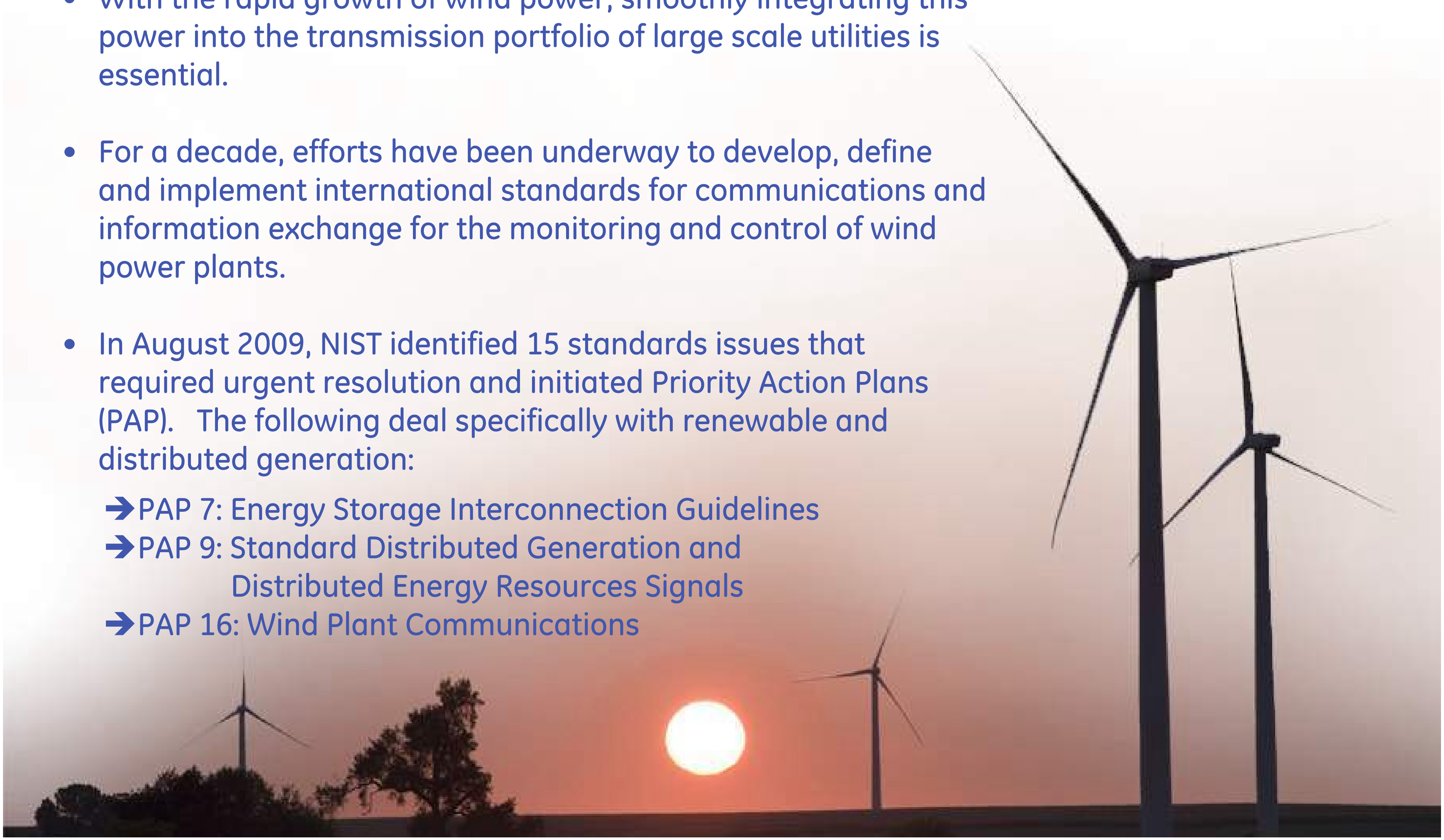
Interoperability standards for emerging energy assets

- With the rapid growth of wind power, smoothly integrating this power into the transmission portfolio of large scale utilities is essential.

- For a decade, efforts have been underway to develop, define and implement international standards for communications and information exchange for the monitoring and control of wind power plants.

- In August 2009, NIST identified 15 standards issues that required urgent resolution and initiated Priority Action Plans (PAP). The following deal specifically with renewable and distributed generation:

  ➔PAP 7: Energy Storage Interconnection Guidelines
  ➔PAP 9: Standard Distributed Generation and Distributed Energy Resources Signals
  ➔PAP 16: Wind Plant Communications



PAP 16: wind plant communications

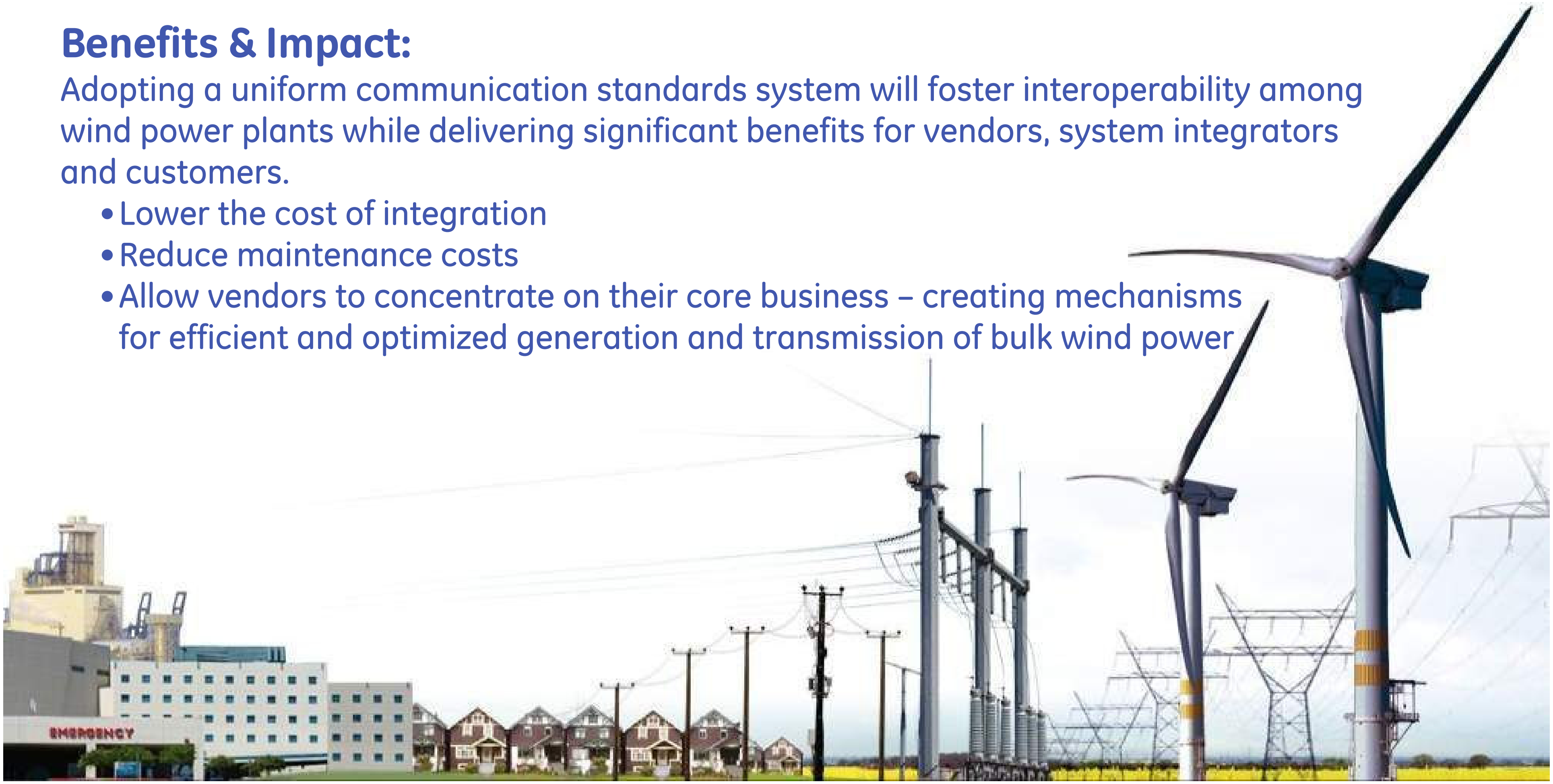
Objectives:

- Gather use cases and requirements from wind industry stakeholders
- Quickly identify gaps that are preventing ubiquitous application of a standard in US
- Ensure Utility Wind Integration Group takes the lead in staffing team

Benefits & Impact:

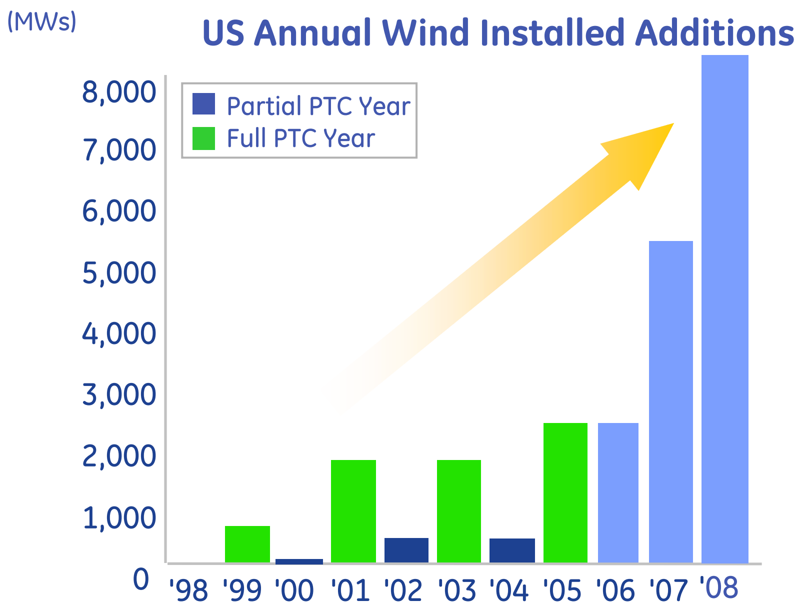
Adopting a uniform communication standards system will foster interoperability among wind power plants while delivering significant benefits for vendors, system integrators and customers.

- Lower the cost of integration
- Reduce maintenance costs
- Allow vendors to concentrate on their core business – creating mechanisms for efficient and optimized generation and transmission of bulk wind power

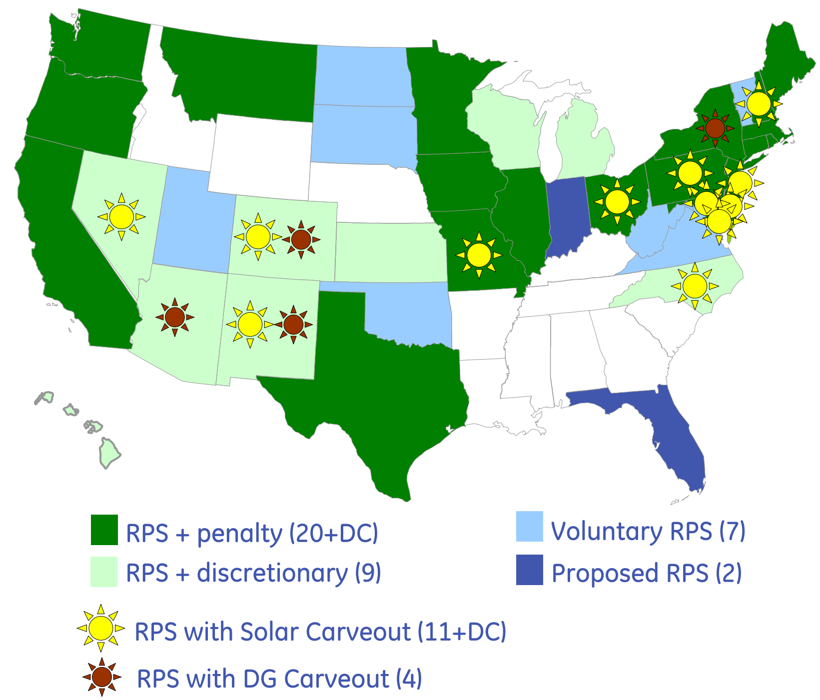


Policy has driven US wind growth

Federal production tax credit



Renewable portfolio standards



Growth drivers

- National incentives
  - PTC … $.021/kWh, 10y
  - ITC … 30%
  - Cash grant in lieu of tax credits (~ITC value)
  - DOE Loan Guarantee Program
- State RPS
  - Jan '07: 22 states … ~44 GW wind '07-25
  - Jan '10: 35 states … ~50 GW wind '10-25

Q&A

Background

ARRA

Indianapolis Power & Light Company ($20,000,000 award)

… Install more than 28K meters, including commercial, industrial and residential customers, provide energy use information to customers, improve service restoration and efficiency, and enable two-way communications and control capabilities for the grid

Midwest Independent Transmission System Operator ($17,271,738 award)

… Install, test, integrate and monitor 150 phasor measurement units in strategic locations across the Midwest on independent transmissions system operators, which will improve the energy dispatching, system reliability and planning capabilties. Will benefit customers in Indiana and several neighboring states

City of Auburn, Indiana ($2,075,080 award)

… Integrate and modernize multiple components within the electrical system, including installing a smart meter network, enhancing relaible and fast communication capabilities, upgrading cyber secuirty technologies, expanding grid monitoring and improving responses to power outages

Key Targets

NO Renewable Portfolio Standard (RPS) target or goal, thus, no additional targets for wind, solar, DG

NO Energy Efficiency Resource Standard (EERS), standalone or as part of RPS

FERC National Assessment of DR Potential

Key drivers of Indiana's demand response potential estimate include: higher-than-average residential CAC saturation of 74 percent, a customer mix that has an above average share of peak demand in the Large C&I class (35%), a moderate amount of existing demand response, and the potential to deploy AMI at an average rate. Enabling technologies and DLC are cost effective for all customer classes in the state.

Edison Foundation IEE July 2010 Updates

- Have tariff rider / surcharge for direct cost recovery
- Pending decoupling for fixed cost recovery
  - *The Utility Regulatory Commission recently approved Vectren's alternative regulatory plan, which included requests for performance incentives and lost revenue recovery. Vectren's decoupling proposal was rejected, but the commission did request that an alternative lost revenue proposal be submitted. Northern Indiana Power & Light and Indianapolis Power & Light have both proposed lost margin recovery mechanisms and both are pending before Commission.*
  - *The state statute allows for either shared savings or adjusted/bonus ROE mechanisms as DSM incentives. Duke Energy has submitted a proposal for an avoided cost recovery charge for EE programs. Vectren Energy Indiana, Northern Indiana Public Service Company (NIPSCO), and Indianapolis Power and Light have also filed DSM plans requesting performance incentives. All cases are currently pending.*
- Pending virtual power plant
  - *Duke Energy's "virtual power plant" model, which combines cost recovery, lost revenue recovery and incentives into an avoided cost charge, has recently been approved in North Carolina and South Carolina. The Ohio Commission approved the VPP program in 2008. Duke has proposed similar mechanisms in Indiana.*
- No dynamic pricing pilots & programs